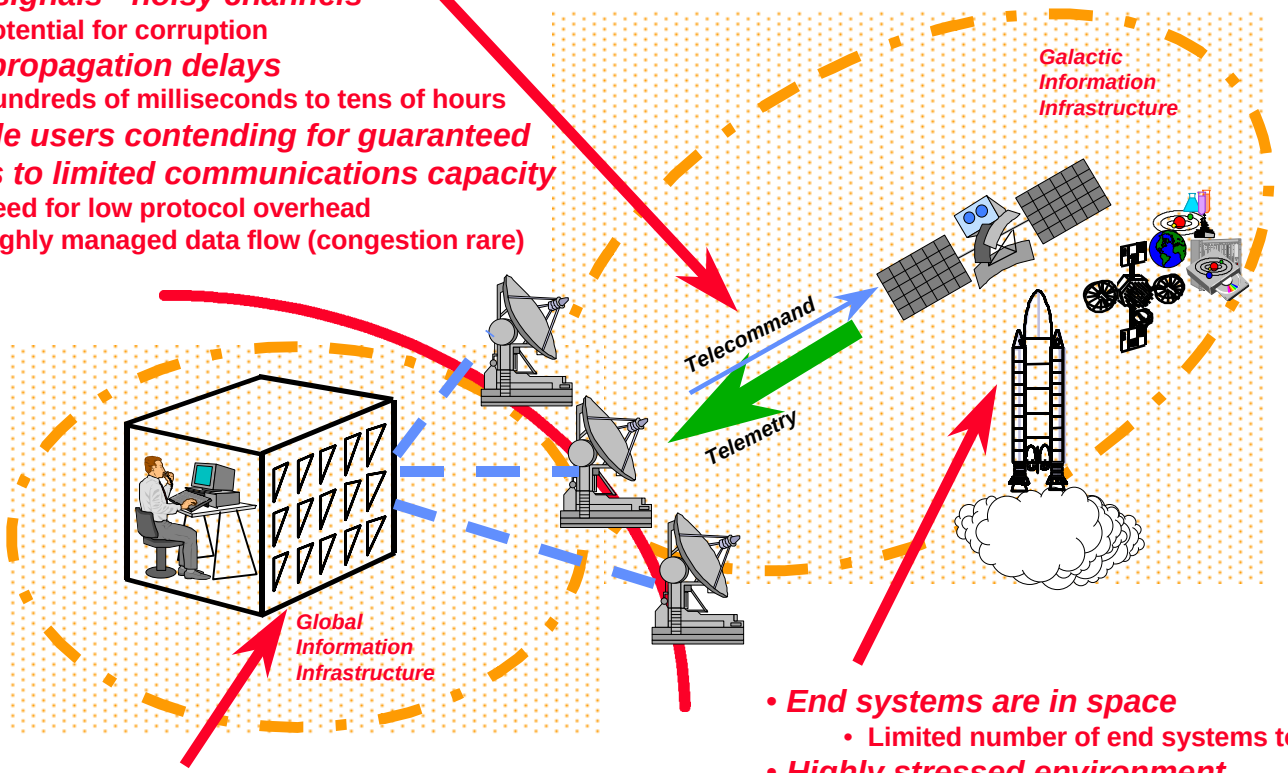
SuperMOCA and the NASA Space Mission Operations Standards Program

AIAA Spacecraft Control Working Group
SCWG-20 Meeting
03 June 1997
Albuquerque, NM

Adrian J. Hooke
NASA Jet Propulsion Laboratory
818.354.3063
adrian.hooke@jpl.nasa.gov

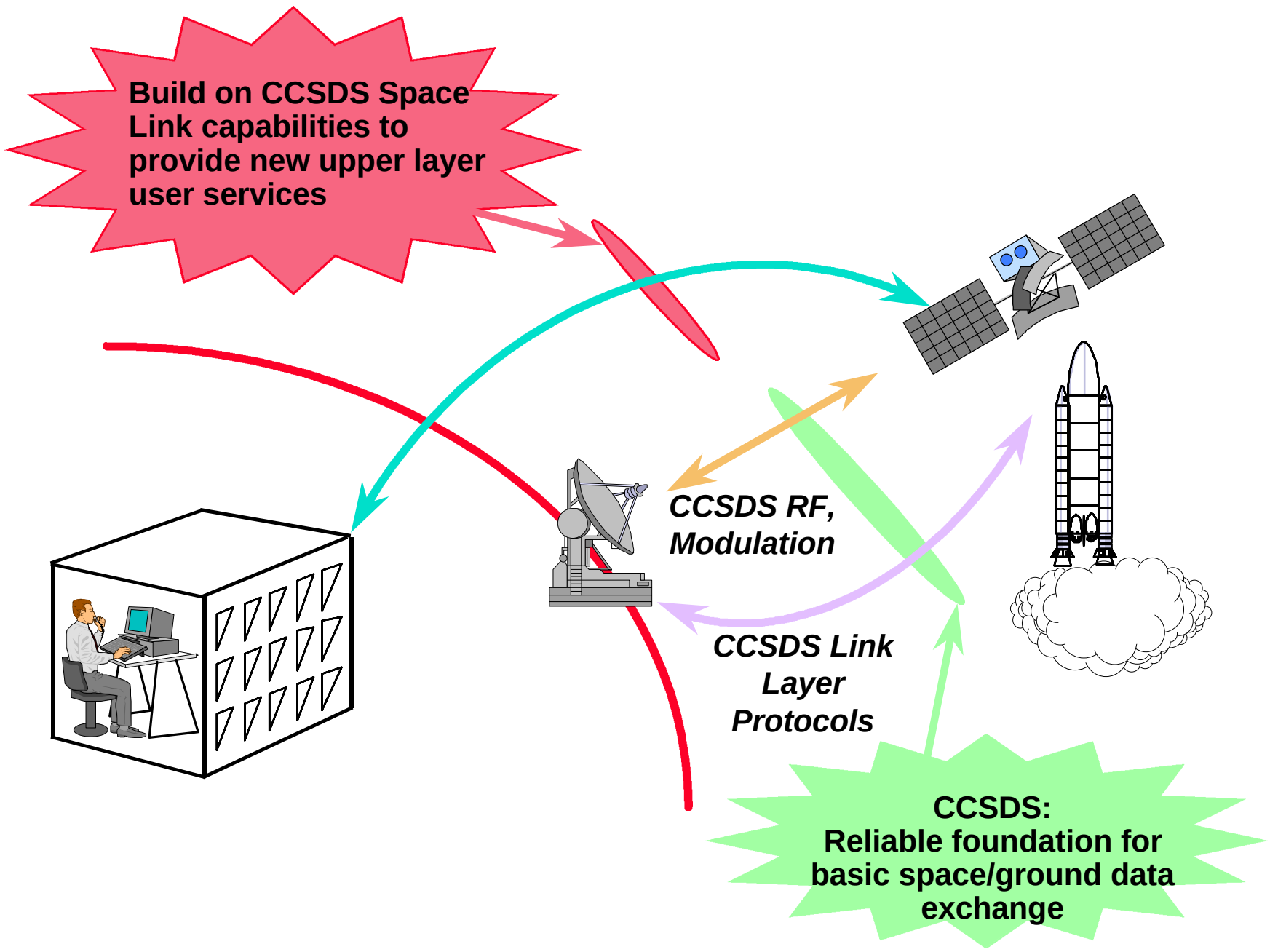
Space Mission Operations Environment

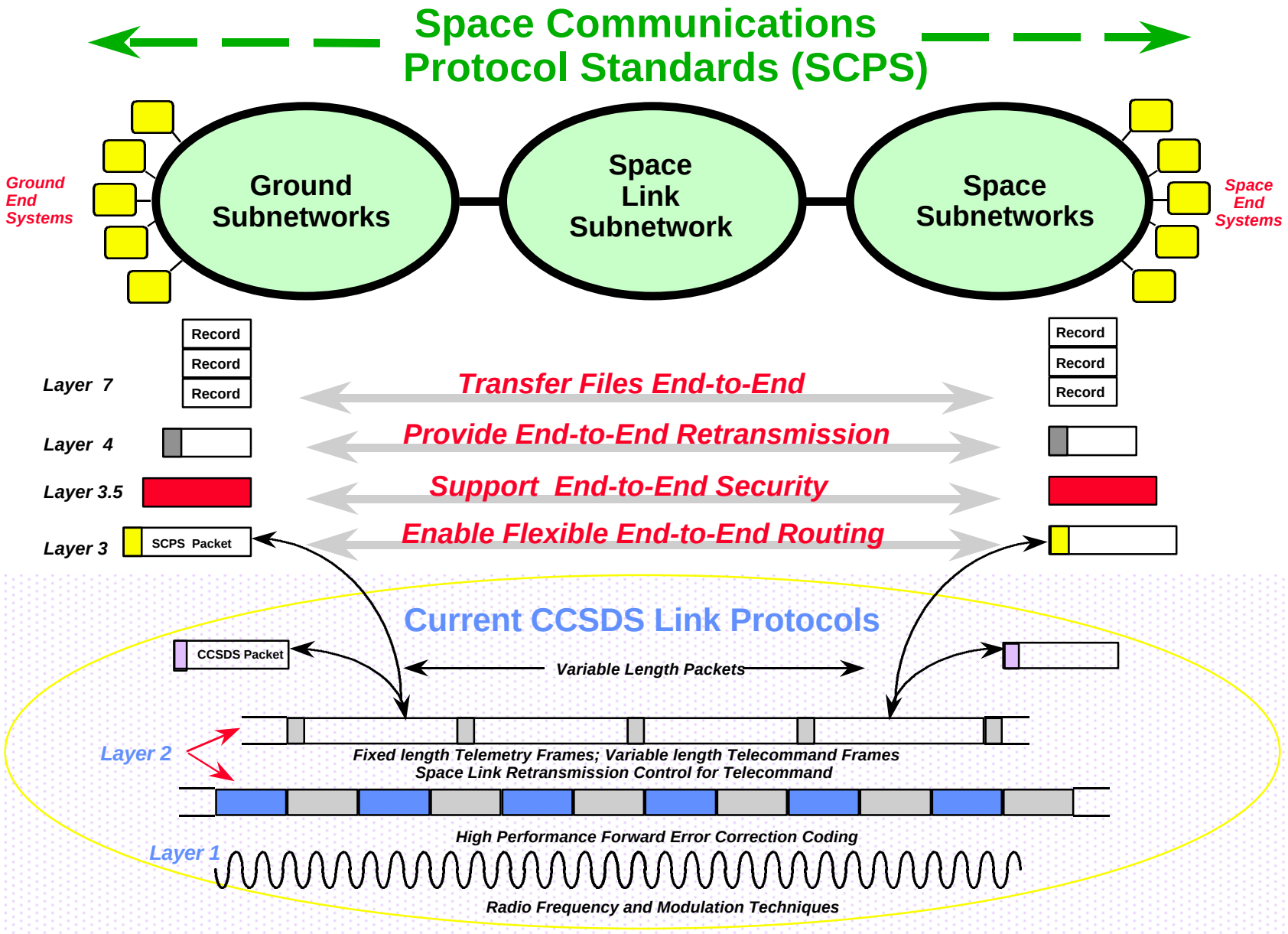
- *Intermittent Connectivity*
  - ~ 10% duty cycle
    - Store-and-forward flavor
  - Possible overlap of ground stations
- *Asymmetric data flow*
  - Sometimes ~ 2000:1
- *Weak signals - noisy channels*
  - Potential for corruption
- *Long propagation delays*
  - Hundreds of milliseconds to tens of hours
- *Multiple users contending for guaranteed access to limited communications capacity*
  - Need for low protocol overhead
  - Highly managed data flow (congestion rare)



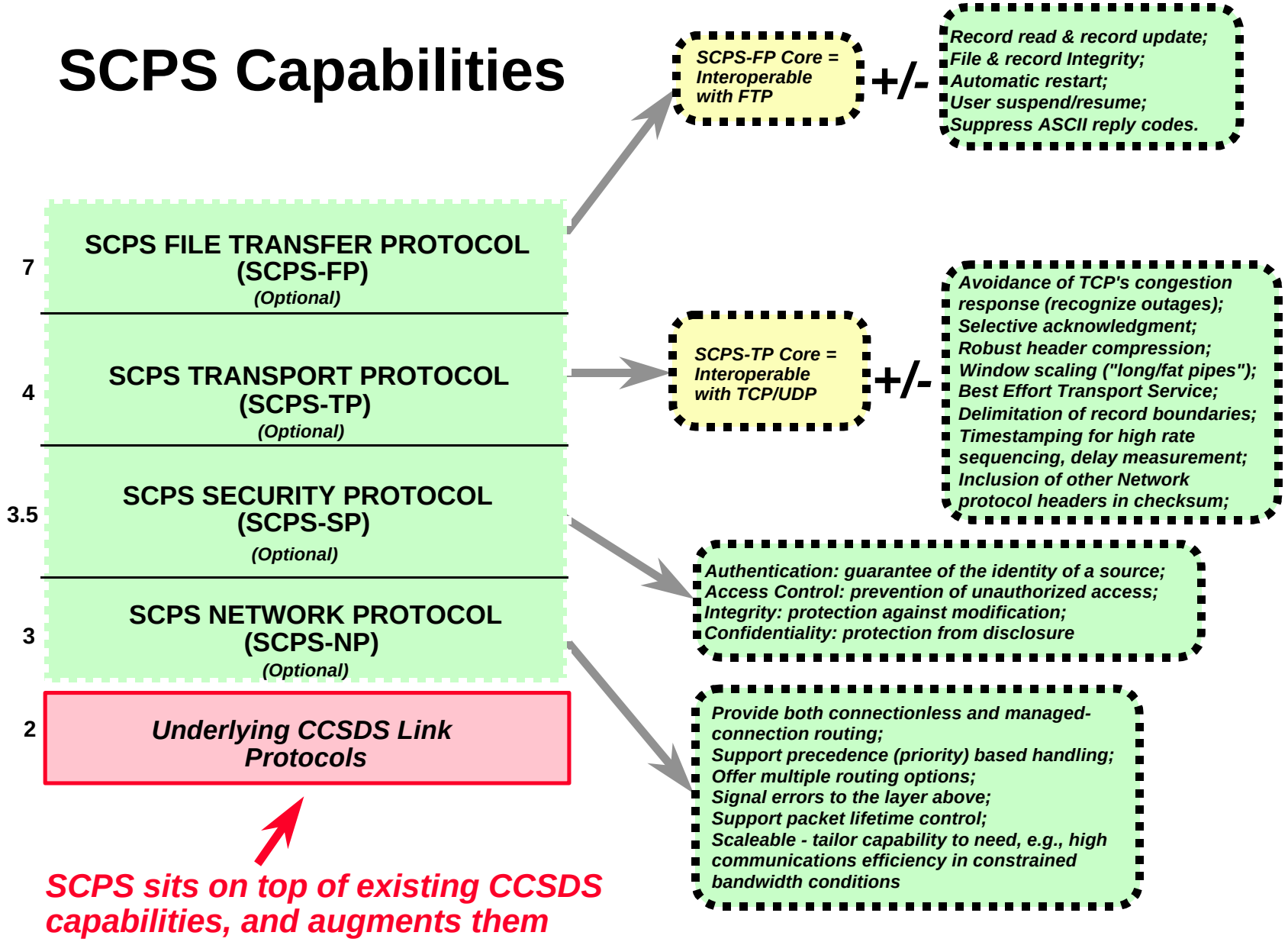
- *Highly constrained operations budgets*
  - Need for COTS or near-COTS systems
- *Modern computing environment*
  - Part of the GII
  - Internet protocol suite
  - Potential for intrusion

- *End systems are in space*
  - Limited number of end systems to be addressed
- *Highly stressed environment*
  - Extreme mass/power/volume constraints
  - Expensive parts qualification
  - Computationally-challenged end systems
    - Heavy loaded with applications software
    - Limited onboard CPU and memory
    - Fairly primitive onboard networks


Build on CCSDS Space Link capabilities to provide new upper layer user services
CCSDS RF, Modulation
CCSDS Link Layer Protocols
CCSDS: Reliable foundation for basic space/ground data exchange


Space Communications
Protocol Standards (SCPS)
Ground End Systems
Ground Subnetworks
Space Link Subnetwork
Space Subnetworks
Space End Systems
Record
Record
Record
Layer 7
Transfer Files End-to-End
Layer 4
Provide End-to-End Retransmission
Layer 3.5
Support End-to-End Security
Layer 3
SCPS Packet
Enable Flexible End-to-End Routing
Current CCSDS Link Protocols
CCSDS Packet
Variable Length Packets
Layer 2
Fixed length Telemetry Frames; Variable length Telecommand Frames
Space Link Retransmission Control for Telecommand
High Performance Forward Error Correction Coding
Layer 1
Radio Frequency and Modulation Techniques

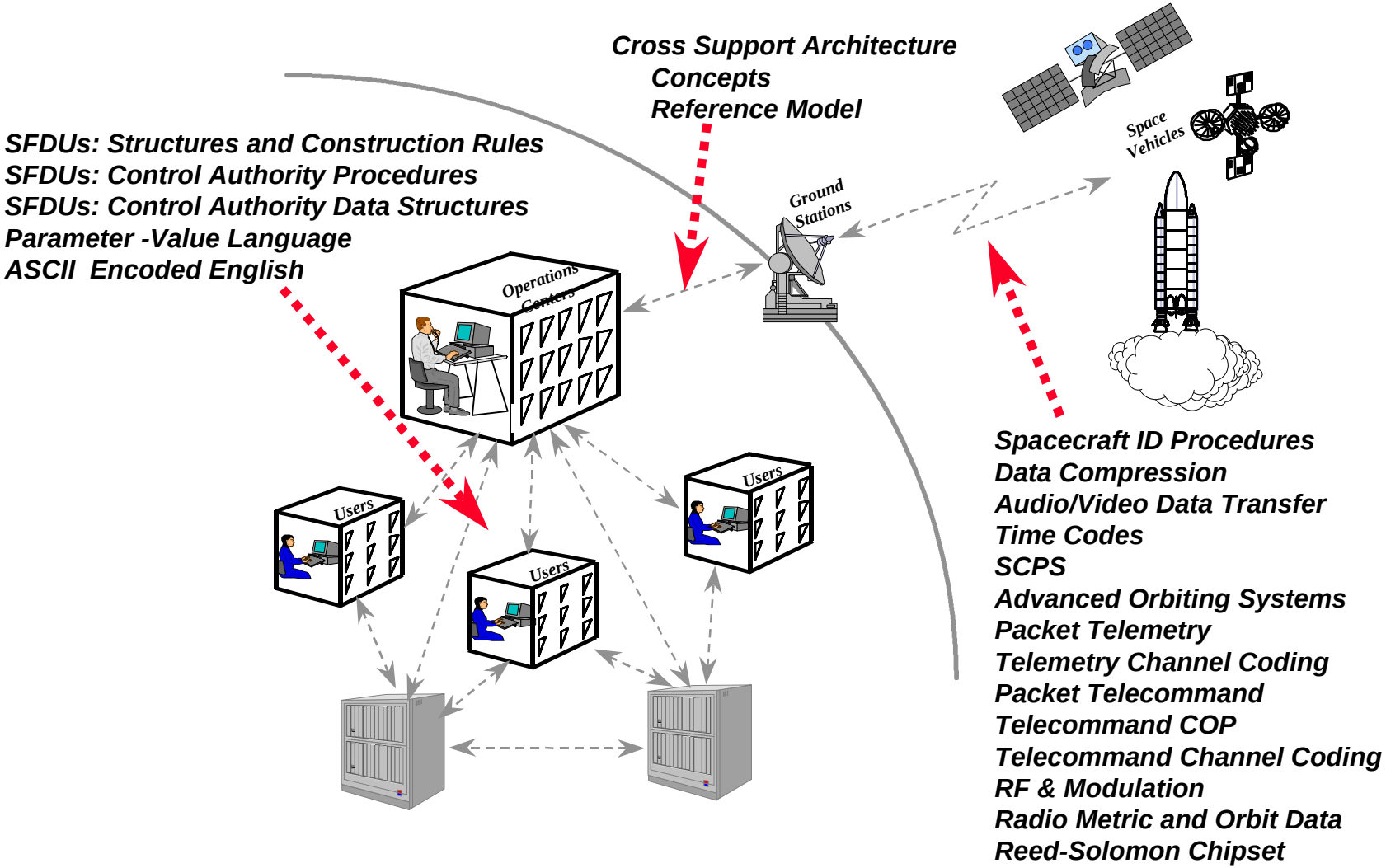
SCPS Capabilities

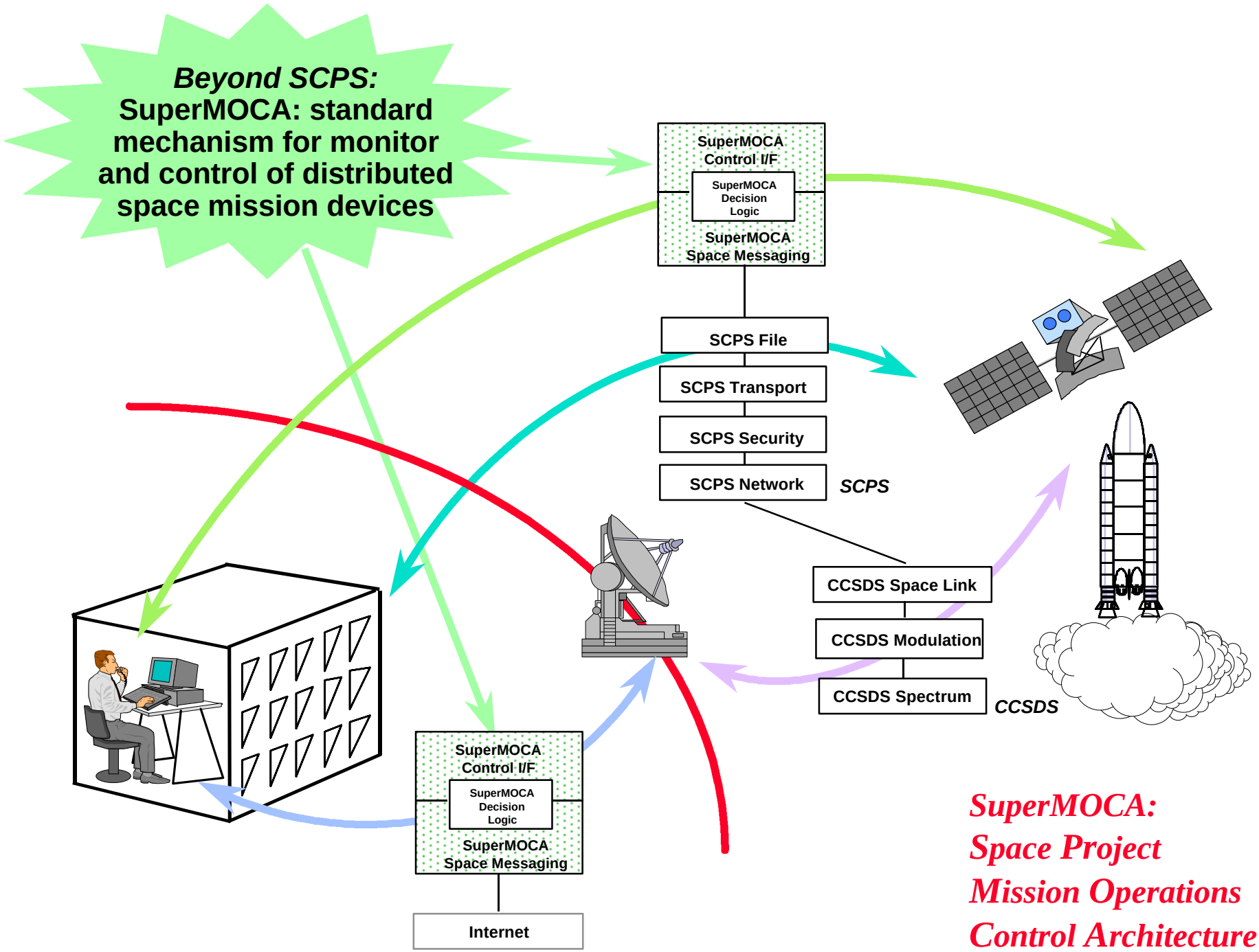


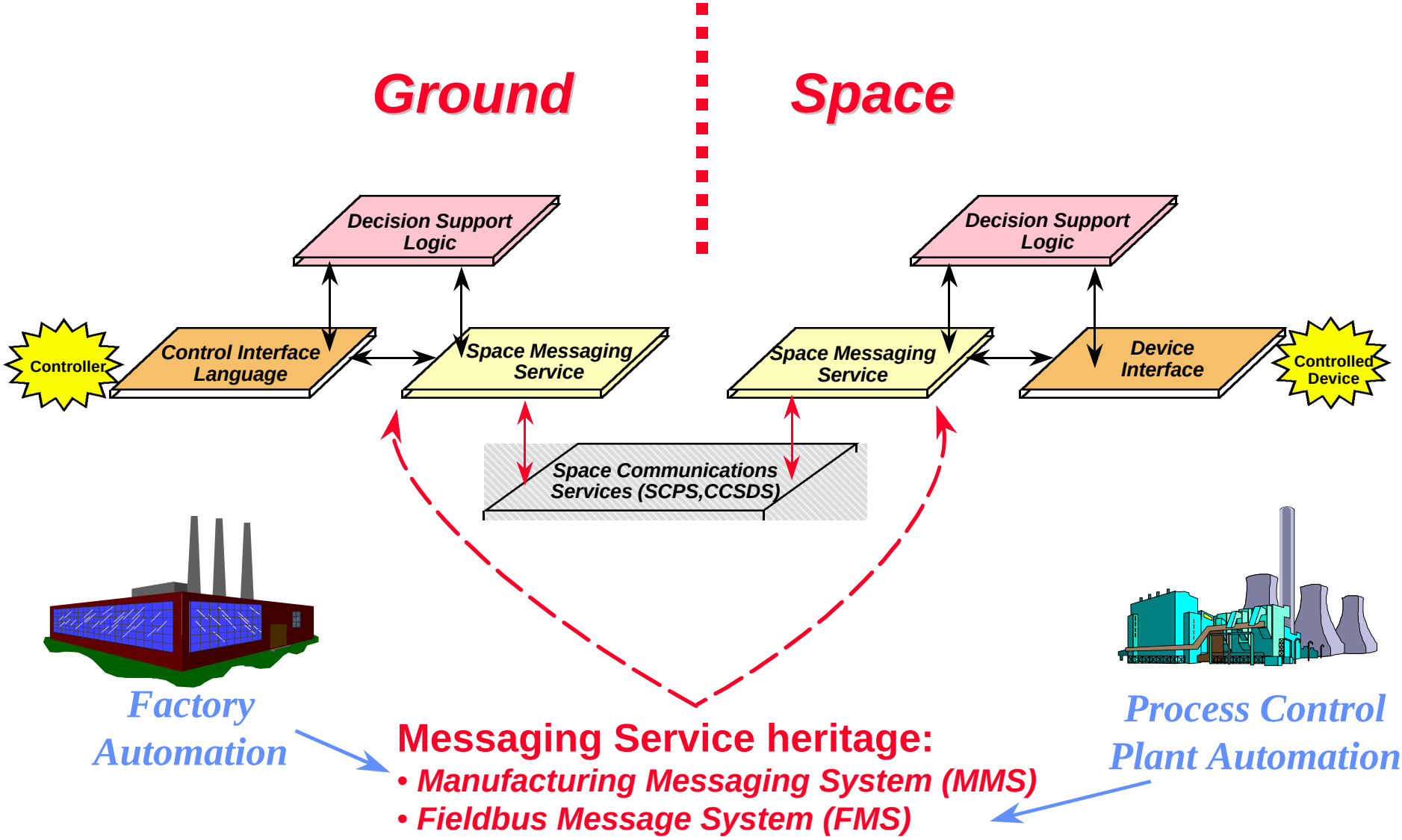
For more information

You can browse the CCSDS Web site and download all doc uments at:

http://bolero.gsfc.nasa.gov/ccsds/ccsds_home.html




Beyond SCPS:
SuperMOCA: standard mechanism for monitor and control of distributed space mission devices
SuperMOCA Control I/F
SuperMOCA Decision Logic
SuperMOCA Space Messaging
SCPS File
SCPS Transport
SCPS Security
SCPS Network
SCPS
CCSDS Space Link
CCSDS Modulation
CCSDS Spectrum
CCSDS
SuperMOCA Control I/F
SuperMOCA Decision Logic
SuperMOCA Space Messaging
Internet
SuperMOCA: Space Project Mission Operations Control Architecture


Ground
Space
Decision Support Logic
Decision Support Logic
Controller
Control Interface Language
Space Messaging Service
Space Messaging Service
Device Interface
Controlled Device
Space Communications Services (SCPS,CCSDS)
Factory Automation
Process Control Plant Automation
Messaging Service heritage:
• Manufacturing Messaging System (MMS)
• Fieldbus Message System (FMS)

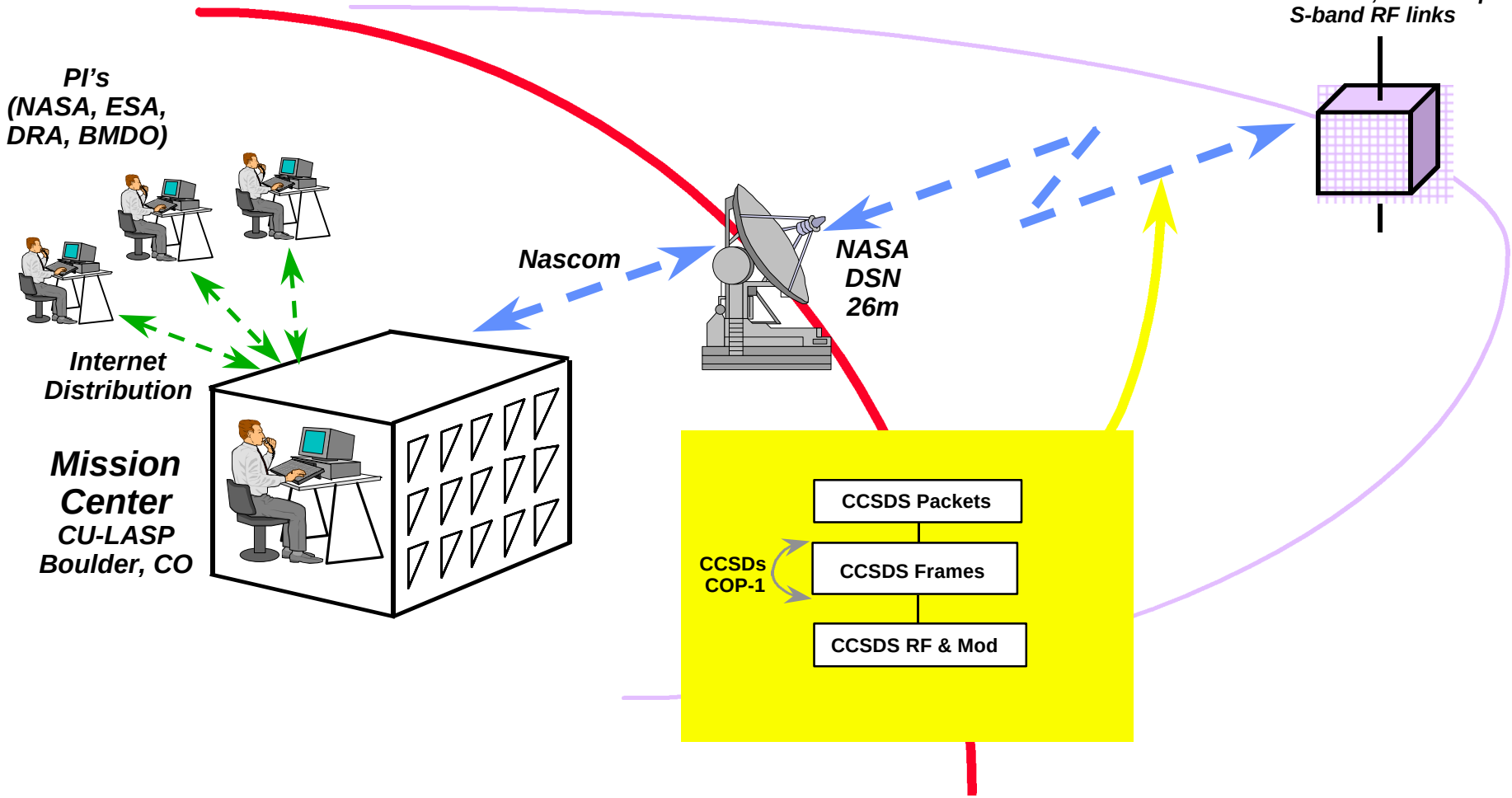
Current STRV-1a/b Extended Mission

(September 1996- October 1997)

STRV-1a/b orbital management delegated by DRA to the US

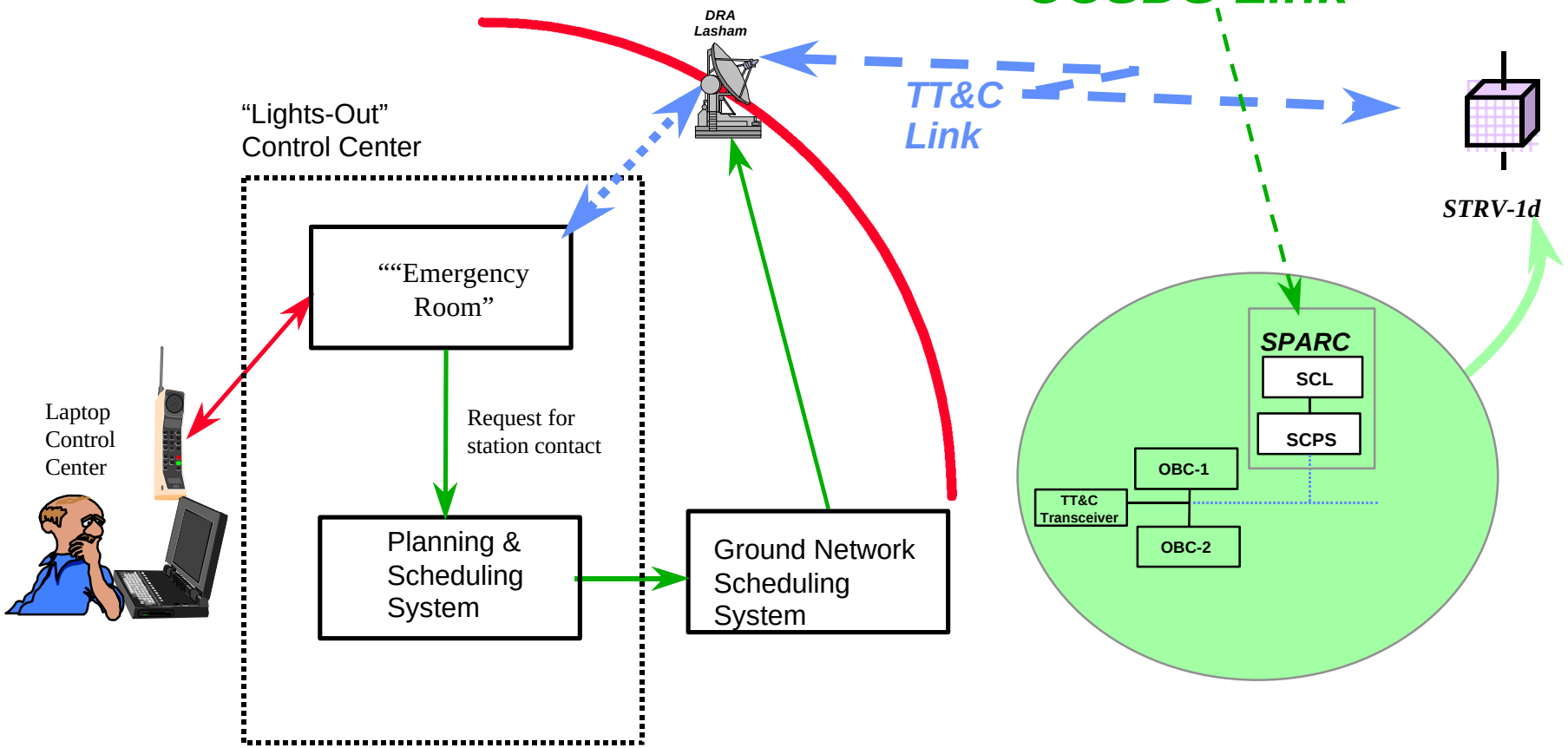
STRV-1a/b
36,000x300Km GTO
Inclination 7-deg
Period 10h35m

Mil-Std 1750A computers
CCSDS Packet TLM/TC
1kb/s down; 100 b/s up
S-band RF links

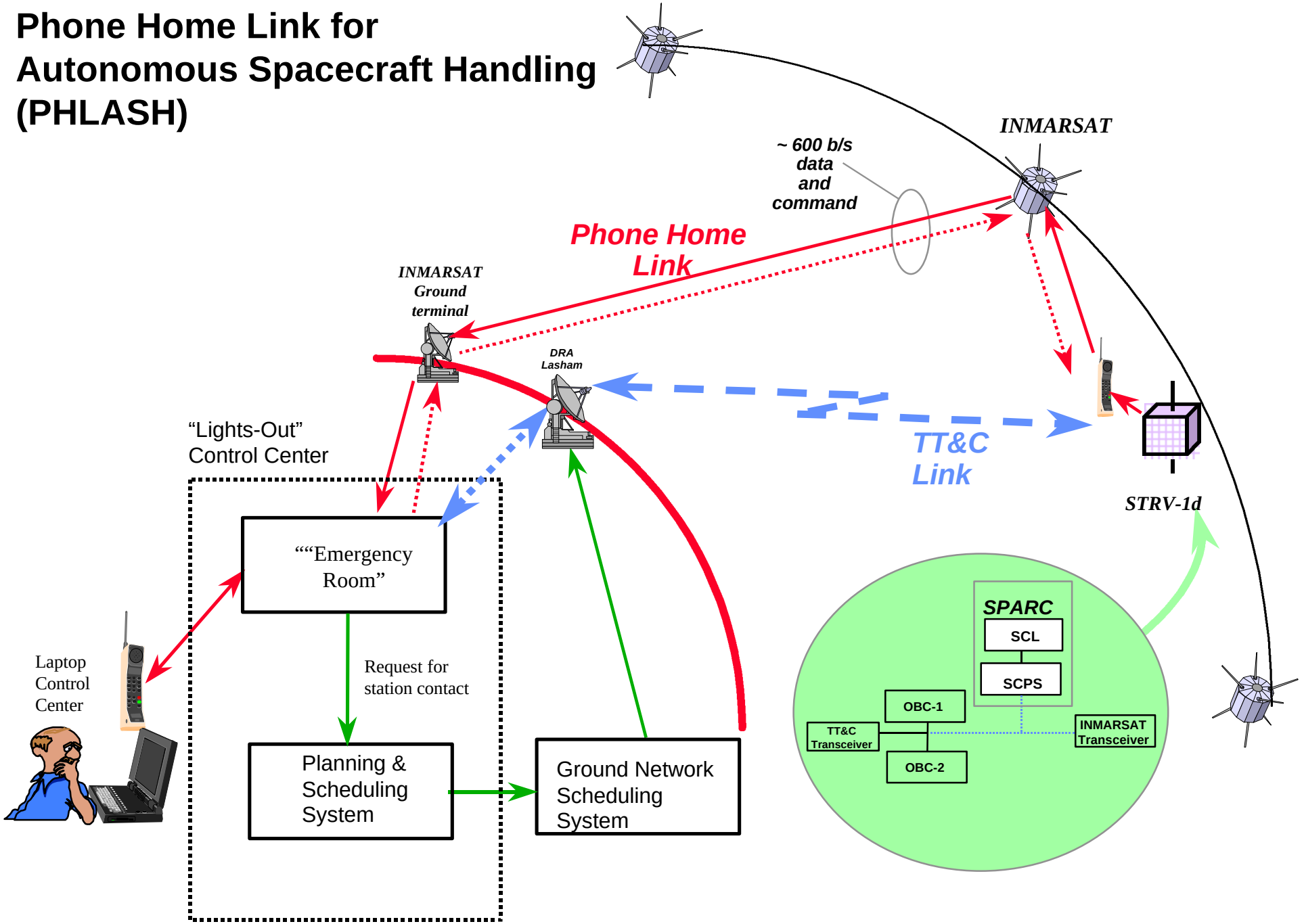


STRV-1d Flight Autonomy Demonstration

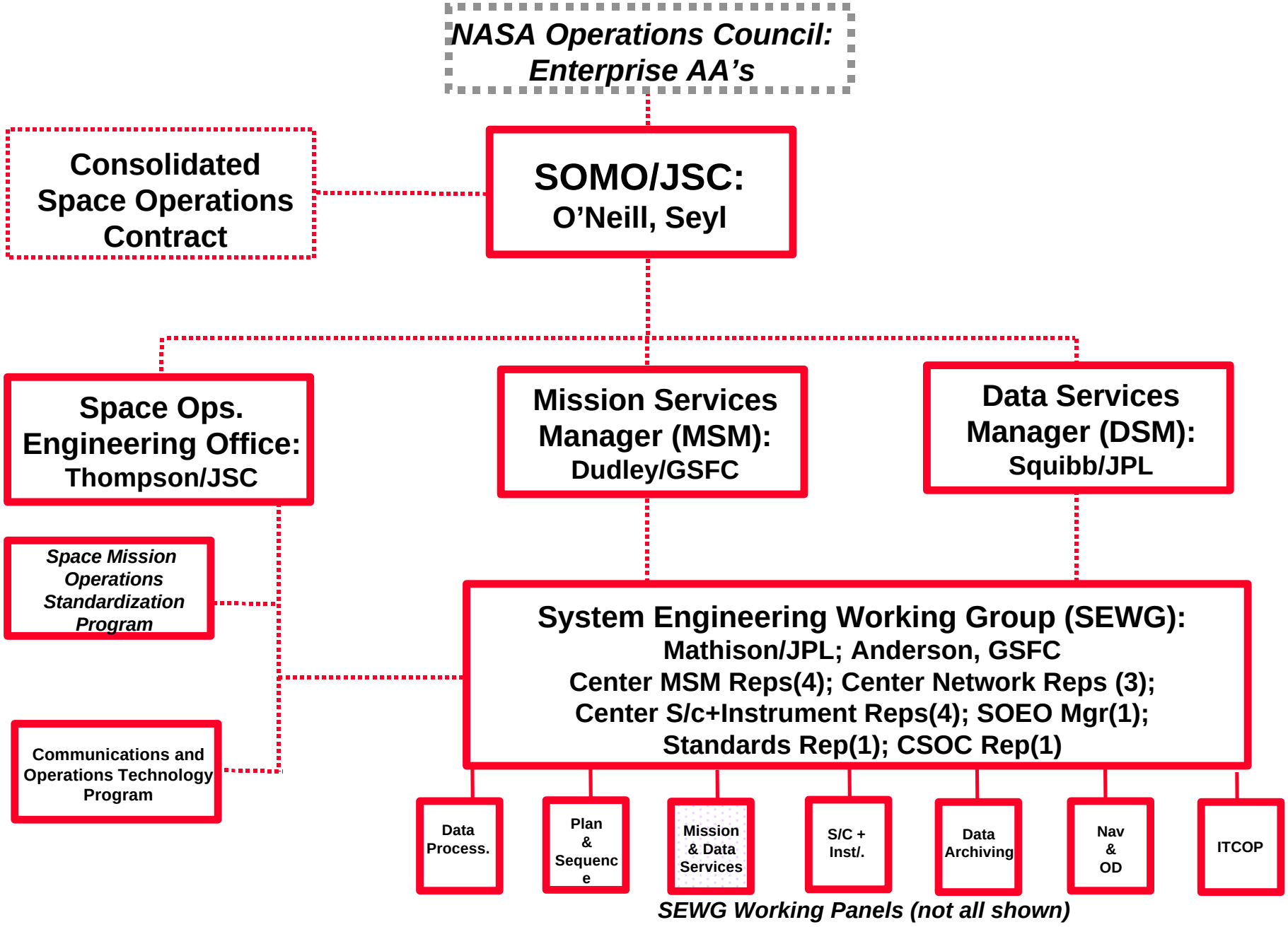
ESAA SPARC
+
Commercial reasoning engine
+
SCPS
+
CCSDS Link

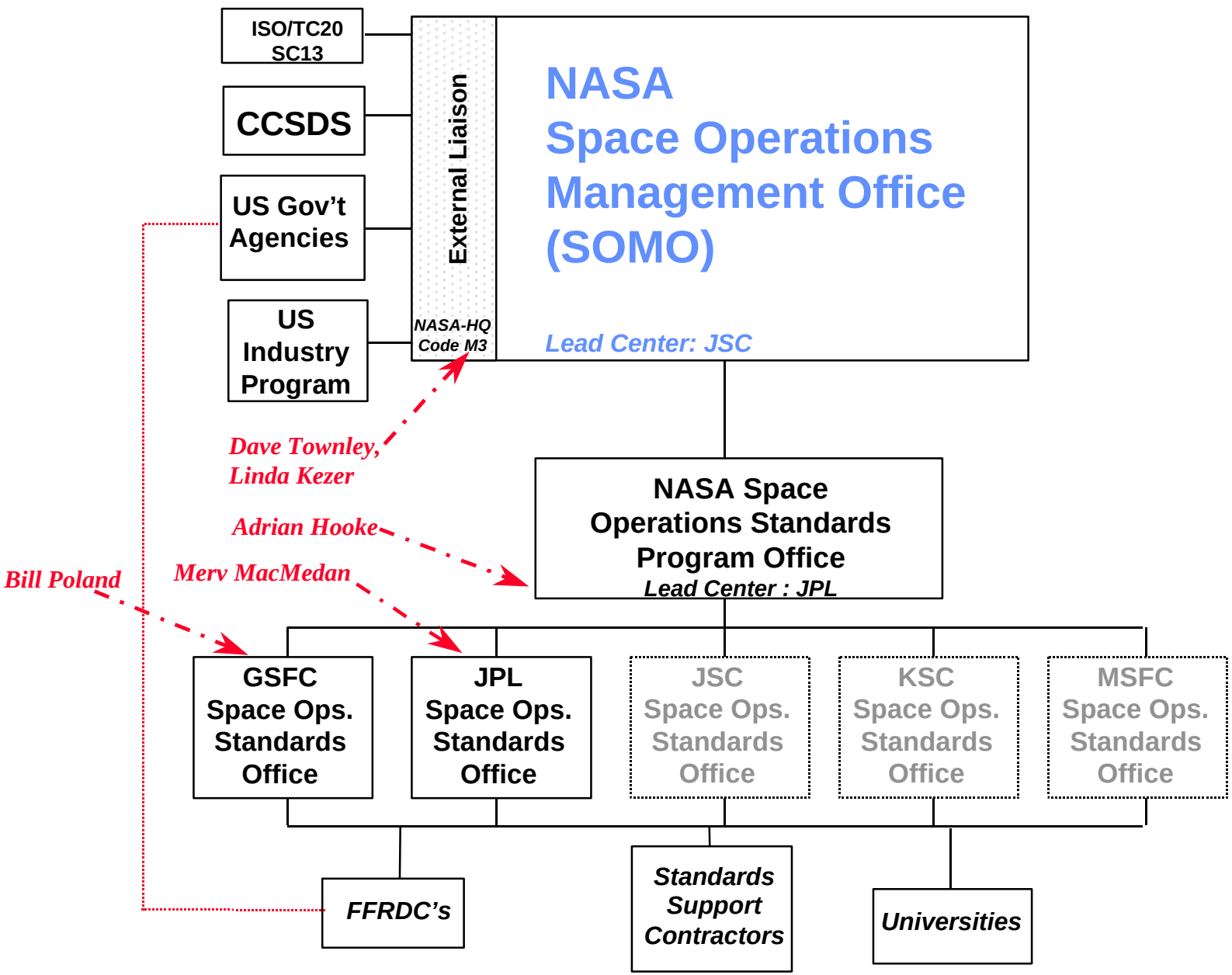


Phone Home Link for Autonomous Spacecraft Handling (PHLASH)

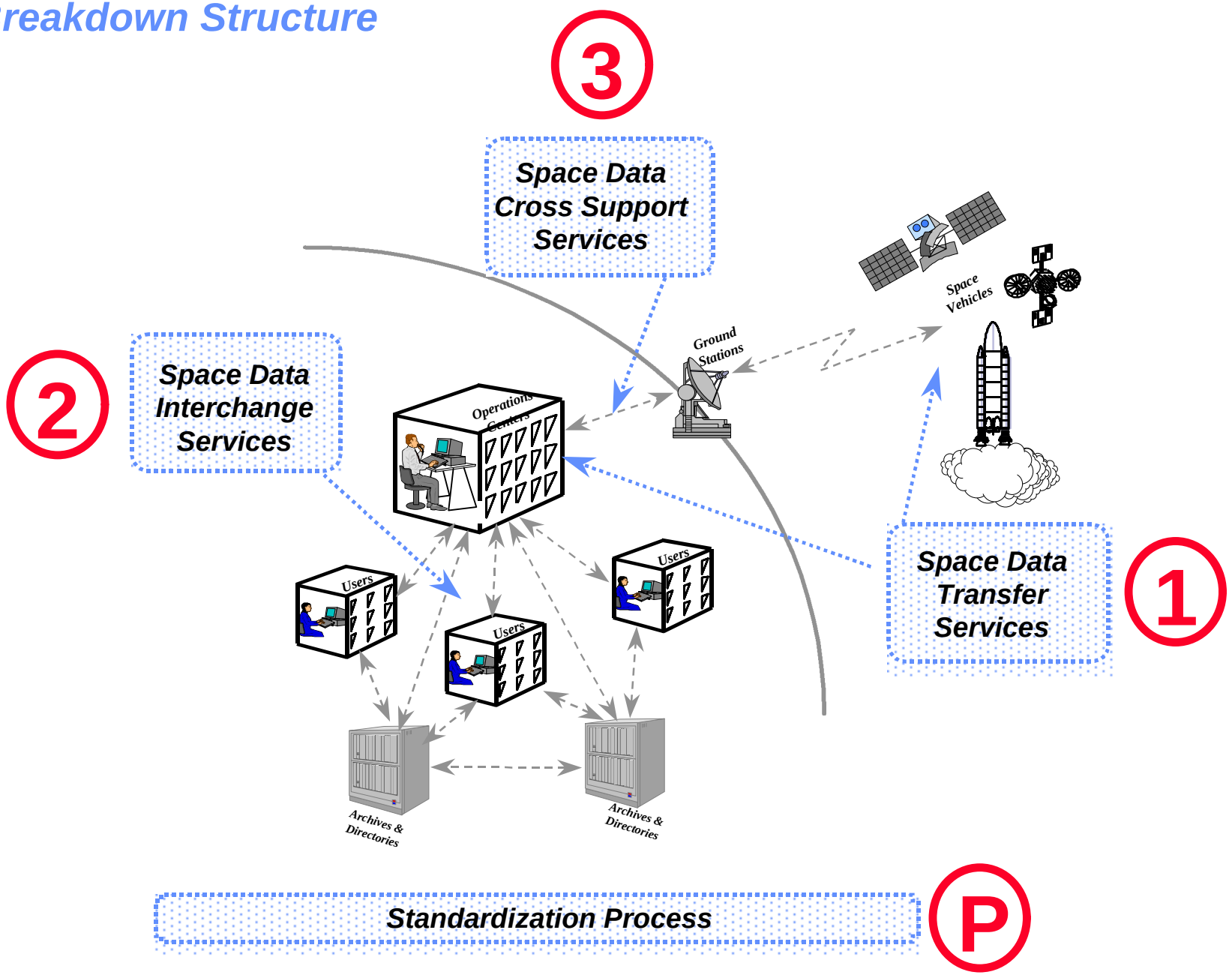


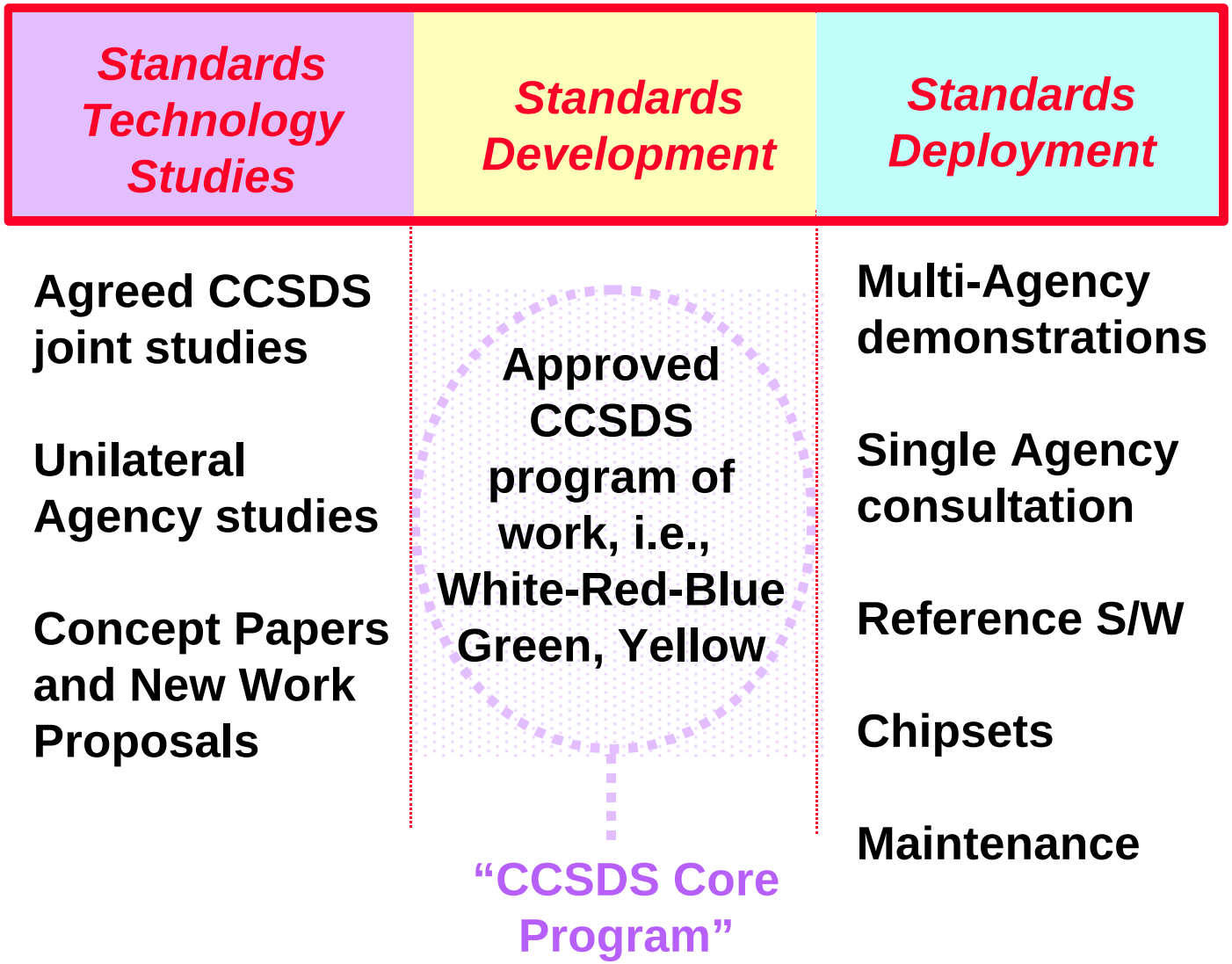
Simple View of the SOMO Organization




ISO/TC20 SC13
CCSDS
US Gov't Agencies
US Industry Program
External Liaison
NASA-HQ Code M3
NASA
Space Operations Management Office (SOMO)
Lead Center: JSC
Dave Townley, Linda Kezer
Adrian Hooke
Merv MacMedan
Bill Poland
NASA Space Operations Standards Program Office
Lead Center : JPL
GSFC Space Ops. Standards Office
JPL Space Ops. Standards Office
JSC Space Ops. Standards Office
KSC Space Ops. Standards Office
MSFC Space Ops. Standards Office
FFRDC's
Standards Support Contractors
Universities

NASA Task Breakdown Structure




Standards Technology Studies
Standards Development
Standards Deployment
Agreed CCSDS joint studies
Unilateral Agency studies
Concept Papers and New Work Proposals
Approved CCSDS program of work, i.e., White-Red-Blue Green, Yellow
"CCSDS Core Program"
Multi-Agency demonstrations
Single Agency consultation
Reference S/W
Chipsets
Maintenance

NASA focus areas for new resources

Standards Technology Studies	*Standards Development*	*Standards Deployment*
Bandwidth-efficient modulation	Panel-1: Turbo Codes	Chipsets
Next generation link protocol & onboard data handling	Panel-3: SLE Services Acceleration	Reference Software
SuperMOCA	Panel-2: General augmentation	